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COMPARISON OF THE COHERENT ATTENUATION PREDICTED BY  
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UNIVERSITY PARK DEPT OF ENGINEERING S. Y HA ET AL

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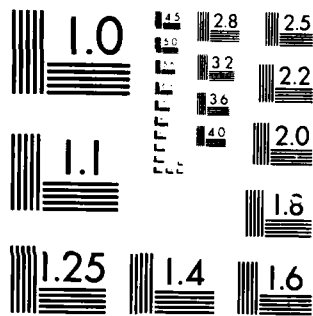
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20. ABSTRACT CONTINUED

decimal place and reveal that, in most cases, if interactions among scatterers are not considered, the coherent attenuation can either be over- or under-estimated. This is a serious problem in communications between distant stations.

*see p. 10 of 10*

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**COMPARISON OF THE COHERENT ATTENUATION PREDICTED BY SINGLE  
AND MULTIPLE SCATTERING THEORIES FOR THE CASE OF SEVERAL  
TYPES OF HYDROMETEORS**

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## Discussion and Results

We have done systematic computation in order to compare the difference in the coherent attenuation predicted using *multiple and single scattering theories*. This is the first study in the literature to examine quantitative results based on two different scattering theories. Therefore one is able to tell the approximate range, in both frequency and concentration regimes, where single scattering theory can be applied for different types of hydrometeors. However, the computations give exact figures up to the four decimal place and reveal that, in most cases, if interactions among scatterers are not considered, the coherent attenuation can either be over- or underestimated. This is a serious problem in communications between distant stations.

To point out the difference between single and multiple scattering theories, sometimes the dB conversion is necessary simply because the normalized imaginary part of the effective wave number  $K$  is on a relative scale and when converted to a physical scale the differences are more noticeable. This is best described by Table for a 5% concentration of scatterers. In calculating the attenuation using dB/m, a scatterer of 1 mm in radius is assumed.

In our computation, ten different scatterers with various concentrations, i.e., 0.05%, 0.1%, 0.3%, 1%, 3% and 5%, and for most cases only the frequency range from  $ka = 0.1$  to 3 is used except for one category of scatterers, whose relative dielectric constant is  $3.19 + 0j$ ,  $ka$  up to 16 is considered. As can be seen from Tables, scatterers of low relative dielectric constant and high dielectric constant with and without lossy mechanism are all considered in obtaining the numerical results. The detailed study can be used as guidelines and calibration computation for future research in *multiple scattering*.

In general, we are able to observe the fact that for lossless scatterers, single scattering theory predicts higher attenuation especially at low frequency range. For all cases, however, there is going to be a transition range where multiple scattering theory yields a higher attenuation than single scattering theory. The transition range depends heavily on the properties of scatterers, which is affected by Mie scattering when the frequency is increased. One may argue that, up to 5%

concentration, the difference between two theories is not critical simply by looking at the values of  $K/k$ . Nevertheless, we emphasize that, the range of concentration used in these computations is just to show the delicate difference between two theories in the extreme cases (low concentration). When the concentration is increased, large difference as well as different physical phenomenon between two theories have been observed in either theoretical derivation or numerical results in our various papers.

For lossy scatterers, the difference of attenuation predicted by two theories is much less than that of lossless scatterers. But, when the frequency is increased, the attenuation using multiple scattering theory seems always larger and a transition range happens at a smaller  $ka$ .

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Table of Cases in Which Single and Multiple Scattering  
were Compared

Relative Dielectric Constant	Frequency Range(ka)	Concentration(%)
$2.0 + 0j$	0.1 - 3.0	0.05, 0.1, 0.3, 1 3, 5
$2.0 + 0.001j$	0.1 - 3.0	"
$2.0 + 0.01j$	0.1 - 3.0	"
Perfect Conducting	0.1 - 3.0 4.0 - 10	" 5
$3.19 + 0j$	0.1 - 3 3.0 - 16	0.05, 0.1, 0.3, 1, 3, 5 1
$3.19 + 1.66 \times 10^{-3}j$	0.1 - 3.0	0.05, 0.1, 0.3, 1, 3, 5
$3.19 + 2 \times 10^{-2}j$	0.1 - 3.0	"
$7.87 + 13.23j$	0.1 - 3.0	0.3, 1, 3, 5
$63.1 + 32.1j$	0.1 - 3.0	0.3, 1, 3, 5
$80.18 + 6.35j$	0.1 - 3.0	1, 3, 5



Comparison of Coherent Attenuation as  
Predicted by Single and Multiple Scattering Theory

Perfect Conducting Sphere $c = 0.05, K = K_R + jK_I$					
ka	$K_I/k$	Multiple Scattering	dB/m	Single Scattering	dB/m
4.0		$0.1061 \times 10^{-1}$	368.63	$0.1003 \times 10^{-1}$	348.48
5.0		$0.8332 \times 10^{-2}$	361.86	$0.7939 \times 10^{-2}$	344.79
6.0		$0.6851 \times 10^{-2}$	357.05	$0.6560 \times 10^{-2}$	341.88
7.0		$0.5795 \times 10^{-2}$	352.35	$0.5589 \times 10^{-2}$	339.82
8.0		$0.5018 \times 10^{-2}$	348.69	$0.4867 \times 10^{-2}$	338.20
9.0		$0.4419 \times 10^{-2}$	345.45	$0.4310 \times 10^{-2}$	336.93
10.0		$0.3939 \times 10^{-2}$	342.14	$0.3867 \times 10^{-2}$	335.89
Dielectric Sphere $c = 0.05, \epsilon = 3.19 + 0j$					
ka	$K_I/k$	Multiple Scattering	dB/m	Single Scattering	dB/m
4.0		$0.1226 \times 10^{-1}$	425.96	$0.1237 \times 10^{-1}$	429.78
5.0		$0.8812 \times 10^{-1}$	3827.05	$0.8498 \times 10^{-1}$	3690.68
6.0		$0.1042 \times 10^{-1}$	543.05	$0.9559 \times 10^{-2}$	498.18
7.0		$0.8038 \times 10^{-2}$	488.73	$0.8079 \times 10^{-2}$	491.22
8.0		$0.6439 \times 10^{-2}$	447.43	$0.6849 \times 10^{-2}$	475.92
9.0		$0.4209 \times 10^{-2}$	329.03	$0.4120 \times 10^{-2}$	322.08
10.0		$0.4820 \times 10^{-2}$	418.66	$0.4554 \times 10^{-2}$	395.56
Dielectric Sphere $c = 0.05, \epsilon = 3.19 + 0.02j$					
ka	$K_I/k$	Multiple Scattering	dB/m	Single Scattering	dB/m
4.0		$0.2496 \times 10^{-2}$	86.72	$0.2474 \times 10^{-2}$	85.96
5.0		$0.1716 \times 10^{-2}$	74.53	$0.1700 \times 10^{-2}$	73.83
6.0		$0.1945 \times 10^{-2}$	101.37	$0.1912 \times 10^{-2}$	99.65
7.0		$0.1642 \times 10^{-2}$	99.84	$0.1616 \times 10^{-2}$	98.26
8.0				$0.1370 \times 10^{-2}$	95.20
9.0		$0.8325 \times 10^{-3}$	65.08	$0.8241 \times 10^{-3}$	64.42
10.0		$0.9520 \times 10^{-3}$	80.35	$0.9108 \times 10^{-3}$	79.11
Remark: $dB/m = 8686(ka)(K_I/k)$ Radius of spherical scatter = 1 mm					

$$\epsilon_r = 3.19 + 0.02j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1757 \times 10^{-3}$	$0.1774 \times 10^{-3}$
0.2		0.2187	0.2448
0.3		0.3361	0.4262
0.4		0.5739	0.7837
0.5		0.9876	$0.1385 \times 10^{-2}$
0.6		$0.1642 \times 10^{-2}$	0.2301
0.7		0.2605	0.3595
0.8		0.3931	0.5309
0.9		0.5640	0.7429
1.0		0.7683	0.9874
1.1		0.9945	$0.1252 \times 10^{-1}$
1.2		$0.1234 \times 10^{-1}$	0.1532
1.3		0.1505	0.1849
1.4		0.1875	0.2264
1.5		0.2431	0.2820
1.6		0.3079	0.3355
1.7		0.3461	0.3553
1.8		0.3455	0.3423
1.9		0.3299	0.3219
2.0		0.3208	0.3110
2.1		0.3310	0.3188
2.2		0.3699	0.3497
2.3		0.4210	0.3843
2.4		0.4288	0.3811
2.5		0.3926	0.3478
2.6		0.3493	0.3115
2.7		0.3169	0.2843
2.8		0.3045	0.2735
2.9		0.3212	0.2870
3.0		0.3400	0.3040

$$\epsilon_r = 3.19 + 0.02j$$

Concentration = 0.03

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1058 \times 10^{-3}$	$0.1065 \times 10^{-3}$
0.2		0.1374	0.1469
0.3		0.2229	0.2557
0.4		0.3934	0.4702
0.5		0.6847	0.8309
0.6		$0.1137 \times 10^{-2}$	$0.1380 \times 10^{-2}$
0.7		0.1789	0.2157
0.8		0.2671	0.3185
0.9		0.3788	0.4457
1.0		0.5103	0.5925
1.1		0.6546	0.7514
1.2		0.8075	0.9193
1.3		0.9807	$0.1109 \times 10^{-1}$
1.4		$0.1214 \times 10^{-1}$	0.1359
1.5		0.1552	0.1692
1.6		0.1920	0.2013
1.7		0.2107	0.2132
1.8		0.2072	0.2054
1.9		0.1964	0.1931
2.0		0.1903	0.1866
2.1		0.1958	0.1913
2.2		0.2171	0.2098
2.3		0.2439	0.2306
2.4		0.2461	0.2287
2.5		0.2254	0.2087
2.6		0.2012	0.1869
2.7		0.1830	0.1706
2.8		0.1758	0.1641
2.9		0.1851	0.1722
3.0		0.1967	0.1824

$$\epsilon_r = 3.19 + 0.02j$$

Concentration = 0.01

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3541 \times 10^{-4}$	$0.3549 \times 10^{-4}$
0.2		0.4790	0.4896
0.3		0.8155	0.8524
0.4		$0.1480 \times 10^{-3}$	$0.1567 \times 10^{-3}$
0.5		0.2603	0.2770
0.6		0.4323	0.4601
0.7		0.6768	0.7191
0.8		$0.1002 \times 10^{-2}$	$0.1062 \times 10^{-2}$
0.9		0.1409	0.1486
1.0		0.1880	0.1975
1.1		0.2393	0.2505
1.2		0.2936	0.3064
1.3		0.3551	0.3698
1.4		0.4367	0.4529
1.5		0.5489	0.5641
1.6		0.6618	0.6710
1.7		0.7091	0.7016
1.8		0.6875	0.6847
1.9		0.6480	0.6438
2.0		0.6266	0.6221
2.1		0.6428	0.6376
2.2		0.7078	0.6994
2.3		0.7836	0.7686
2.4		0.7818	0.7622
2.5		0.7146	0.6956
2.6		0.6394	0.6230
2.7		0.5828	0.5685
2.8		0.5603	0.5470
2.9		0.5887	0.5741
3.0		0.6247	0.6079

$$\epsilon_r = 3.19 + 0.02j$$

$$\text{Concentration} = 0.003$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1064 \times 10^{-4}$	$0.1065 \times 10^{-4}$
0.2		0.1459	0.1469
0.3		0.2524	0.2557
0.4		0.4623	0.4702
0.5		0.8158	0.8309
0.6		$0.1355 \times 10^{-3}$	$0.1380 \times 10^{-3}$
0.7		0.2119	0.2157
0.8		0.3131	0.3185
0.9		0.4387	0.4457
1.0		0.5838	0.5925
1.1		0.7412	0.7514
1.2		0.9076	0.9193
1.3		$0.1096 \times 10^{-2}$	$0.1109 \times 10^{-2}$
1.4		0.1344	0.1359
1.5		0.1679	0.1692
1.6		0.2005	0.2013
1.7		0.2131	0.2132
1.8		0.2057	0.2054
1.9		0.1935	0.1931
2.0		0.1870	0.1866
2.1		0.1918	0.1913
2.2		0.2106	0.2098
2.3		0.2319	0.2306
2.4		0.2304	0.2287
2.5		0.2104	0.2087
2.6		0.1884	0.1869
2.7		0.1719	0.1706
2.8		0.1653	0.1641
2.9		0.1735	0.1722
3.0		0.1839	0.1824

$$\epsilon_r = 3.19 + 0.02j$$

Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3548 \times 10^{-5}$	$0.3549 \times 10^{-5}$
0.2		0.4886	0.4896
0.3		0.8487	0.8524
0.4		$0.1559 \times 10^{-4}$	$0.1567 \times 10^{-4}$
0.5		0.2753	0.2770
0.6		0.4573	0.4601
0.7		0.7148	0.7191
0.8		$0.1053 \times 10^{-3}$	$0.1062 \times 10^{-3}$
0.9		0.1478	0.1486
1.0		0.1965	0.1975
1.1		0.2493	0.2505
1.2		0.3051	0.3064
1.3		0.3683	0.3698
1.4		0.4512	0.4529
1.5		0.5626	0.5641
1.6		0.6701	0.6710
1.7		0.7105	0.7106
1.8		0.6850	0.6847
1.9		0.6442	0.6438
2.0		0.6225	0.6221
2.1		0.6381	0.6376
2.2		0.7003	0.6994
2.3		0.7701	0.7686
2.4		0.7642	0.7622
2.5		0.6975	0.6956
2.6		0.6246	0.6230
2.7		0.5700	0.5685
2.8		0.5483	0.5470
2.9		0.5755	0.5741
3.0		0.6096	0.6079

$$\epsilon_r = 3.19 + 0.02j$$

Concentration = 0.0005

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1774 \times 10^{-5}$	$0.1774 \times 10^{-5}$
0.2		0.2445	0.2448
0.3		0.4253	0.4262
0.4		0.7815	0.7837
0.5		$0.1381 \times 10^{-4}$	$0.1385 \times 10^{-5}$
0.6		0.2294	0.2310
0.7		0.3585	0.3595
0.8		0.5293	0.5309
0.9		0.7409	0.7429
1.0		0.9850	0.9874
1.1		$0.1249 \times 10^{-3}$	$0.1252 \times 10^{-3}$
1.2		0.1529	0.1532
1.3		0.1845	0.1849
1.4		0.2260	0.2264
1.5		0.2817	0.2820
1.6		0.3353	0.3355
1.7		0.3553	0.3553
1.8		0.3424	0.3423
1.9		0.3220	0.3219
2.0		0.3112	0.3110
2.1		0.3189	0.3188
2.2		0.3499	0.3497
2.3		0.3847	0.3843
2.4		0.3816	0.3811
2.5		0.3483	0.3478
2.6		0.3119	0.3115
2.7		0.2846	0.2843
2.8		0.2738	0.2735
2.9		0.2874	0.2870
3.0		0.3044	0.3040

$$\epsilon_r = 3.19 + 1.66 \times 10^{-3}j \quad \text{Concentration} = 0.05$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1963 \times 10^{-4}$	$0.2291 \times 10^{-4}$
0.2		0.5935	0.8634
0.3		$0.1713 \times 10^{-3}$	$0.2611 \times 10^{-3}$
0.4		0.4011	0.6092
0.5		0.8044	$0.1199 \times 10^{-2}$
0.6		$0.1446 \times 10^{-2}$	0.2101
0.7		0.2394	0.3380
0.8		0.3705	0.5078
0.9		0.5399	0.7185
1.0		0.7426	0.9621
1.1		0.9674	$0.1226 \times 10^{-1}$
1.2		$0.1205 \times 10^{-1}$	0.1505
1.3		0.1473	0.1820
1.4		0.1840	0.2236
1.5		0.2402	0.2804
1.6		0.3074	0.3363
1.7		0.3477	0.3577
1.8		0.3474	0.3444
1.9		0.3309	0.3229
2.0		0.3208	0.3113
2.1		0.3305	0.3187
2.2		0.3705	0.3508
2.3		0.4257	0.3886
2.4		0.4355	0.3864
2.5		0.3977	0.3517
2.6		0.3525	0.3139
2.7		0.3186	0.2856
2.8		0.3054	0.2741
2.9		0.3238	0.2889
3.0		0.3468	0.3093



$$\epsilon_r = 3.19 + 0.166 \times 10^{-3}j \quad \text{Concentration} = 0.03$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1256 \times 10^{-4}$	$0.1375 \times 10^{-4}$
0.2		0.4201	0.5181
0.3		$0.1239 \times 10^{-3}$	$0.1567 \times 10^{-3}$
0.4		0.2893	0.3655
0.5		0.5740	0.7192
0.6		$0.1018 \times 10^{-2}$	$0.1260 \times 10^{-2}$
0.7		0.1661	0.2028
0.8		0.2534	0.3047
0.9		0.3642	0.4311
1.0		0.4949	0.5772
1.1		0.6385	0.7356
1.2		0.7903	0.9028
1.3		0.9620	$0.1092 \times 10^{-1}$
1.4		$0.1195 \times 10^{-1}$	0.1342
1.5		0.1537	0.1682
1.6		0.1920	0.2018
1.7		0.2119	0.2146
1.8		0.2084	0.2066
1.9		0.1970	0.1938
2.0		0.1904	0.1868
2.1		0.1955	0.1912
2.2		0.2176	0.2105
2.3		0.2466	0.2332
2.4		0.2498	0.2318
2.5		0.2282	0.2110
2.6		0.2030	0.1884
2.7		0.1839	0.1714
2.8		0.1762	0.1645
2.9		0.1864	0.1733
3.0		0.2004	0.1856

$$\epsilon_r = 3.19 + 1.66 \times 10^{-3}j \quad \text{Concentration} = 0.01$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.4450 \times 10^{-5}$	$0.4583 \times 10^{-5}$
0.2		$0.1617 \times 10^{-4}$	$0.1727 \times 10^{-4}$
0.3		0.4854	0.5222
0.4		$0.1133 \times 10^{-3}$	$0.1219 \times 10^{-3}$
0.5		0.2232	0.2397
0.6		0.3924	0.4201
0.7		0.6339	0.6760
0.8		0.9565	$0.1016 \times 10^{-2}$
0.9		$0.1360 \times 10^{-2}$	0.1437
1.0		0.1829	0.1924
1.1		0.2340	0.2452
1.2		0.2880	0.3009
1.3		0.3492	0.3640
1.4		0.4307	0.4473
1.5		0.5450	0.5607
1.6		0.6628	0.6726
1.7		0.7136	0.7153
1.8		0.6916	0.6887
1.9		0.6501	0.6459
2.0		0.6270	0.6225
2.1		0.6241	0.6374
2.2		0.7098	0.7017
2.3		0.7924	0.7773
2.4		0.7929	0.7728
2.5		0.7229	0.7034
2.6		0.6447	0.6279
2.7		0.5856	0.5712
2.8		0.5617	0.5482
2.9		0.5926	0.5777
3.0		0.6360	0.6186

$$\epsilon_r = 3.19 + 1.66 \times 10^{-3}j \quad \text{Concentration} = 0.003$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1363 \times 10^{-5}$	$0.1375 \times 10^{-5}$
0.2		0.5081	0.5181
0.3		$0.1533 \times 10^{-4}$	$0.1567 \times 10^{-4}$
0.4		0.3577	0.3655
0.5		0.7042	0.7192
0.6		$0.1235 \times 10^{-3}$	$0.1260 \times 10^{-3}$
0.7		0.1990	0.2028
0.8		0.2993	0.3047
0.9		0.4241	0.4311
1.0		0.5686	0.5772
1.1		0.7254	0.7356
1.2		0.8911	0.9028
1.3		$0.1079 \times 10^{-2}$	$0.1092 \times 10^{-2}$
1.4		0.1327	0.1342
1.5		0.1668	0.1682
1.6		0.2009	0.2018
1.7		0.2145	0.2146
1.8		0.2069	0.2066
1.9		0.1942	0.1938
2.0		0.1872	0.1868
2.1		0.1917	0.1912
2.2		0.2112	0.2105
2.3		0.2345	0.2332
2.4		0.2337	0.2318
2.5		0.2128	0.2110
2.6		0.1899	0.1884
2.7		0.1727	0.1714
2.8		0.1657	0.1645
2.9		0.1747	0.1733
3.0		0.1872	0.1856

$$\epsilon_r = 3.19 + 1.66 \times 10^{-3}j \quad \text{Concentration} = 0.001$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.4569 \times 10^{-6}$	$0.4583 \times 10^{-6}$
0.2		$0.1716 \times 10^{-5}$	$0.1727 \times 10^{-5}$
0.3		0.5185	0.5222
0.4		$0.1210 \times 10^{-4}$	$0.1219 \times 10^{-4}$
0.5		0.2381	0.2397
0.6		0.4173	0.4201
0.7		0.6717	0.6760
0.8		$0.1010 \times 10^{-3}$	$0.1016 \times 10^{-3}$
0.9		0.1429	0.1437
1.0		0.1914	0.1924
1.1		0.2441	0.2452
1.2		0.2996	0.3009
1.3		0.3625	0.3640
1.4		0.4456	0.4473
1.5		0.5592	0.5607
1.6		0.6717	0.6726
1.7		0.7152	0.7153
1.8		0.6890	0.6887
1.9		0.6463	0.6459
2.0		0.6230	0.6225
2.1		0.6379	0.6374
2.2		0.7025	0.7017
2.3		0.7788	0.7773
2.4		0.7748	0.7728
2.5		0.7054	0.7034
2.6		0.6296	0.6279
2.7		0.5726	0.5712
2.8		0.5496	0.5482
2.9		0.5792	0.5777
3.0		0.6203	0.6186

$$\epsilon_r = 3.19 + 1.66 \times 10^{-3}j \quad \text{Concentration} = 0.0005$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2288 \times 10^{-6}$	$0.2291 \times 10^{-6}$
0.2		0.8607	0.8634
0.3		$0.2602 \times 10^{-5}$	$0.2611 \times 10^{-5}$
0.4		0.6071	0.6092
0.5		$0.1194 \times 10^{-4}$	$0.1199 \times 10^{-4}$
0.6		0.2093	0.2101
0.7		0.3369	0.3380
0.8		0.5063	0.5078
0.9		0.7165	0.7185
1.0		0.9596	0.9621
1.1		$0.1223 \times 10^{-3}$	$0.1226 \times 10^{-3}$
1.2		0.1501	0.1505
1.3		0.1816	0.1820
1.4		0.2232	0.2236
1.5		0.2800	0.2804
1.6		0.3361	0.3363
1.7		0.3576	0.3577
1.8		0.3444	0.3444
1.9		0.3231	0.3229
2.0		0.3114	0.3113
2.1		0.3188	0.3187
2.2		0.3510	0.3508
2.3		0.3890	0.3886
2.4		0.3869	0.3864
2.5		0.3522	0.3517
2.6		0.3144	0.3139
2.7		0.2860	0.2856
2.8		0.2745	0.2741
2.9		0.2892	0.2889
3.0		0.3097	0.3093

$$\epsilon_r = 3.19 + 0j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.5510 \times 10^{-5}$	$0.8927 \times 10^{-5}$
0.2		$0.4493 \times 10^{-4}$	$0.7200 \times 10^{-4}$
0.3		$0.1563 \times 10^{-3}$	$0.2462 \times 10^{-3}$
0.4		0.3854	0.5935
0.5		0.7878	$0.1182 \times 10^{-2}$
0.6		$0.1428 \times 10^{-2}$	0.2082
0.7		0.2375	0.3361
0.8		0.3684	0.5057
0.9		0.5376	0.7163
1.0		0.7403	0.9598
1.1		0.9650	$0.1224 \times 10^{-1}$
1.2		$0.1203 \times 10^{-1}$	0.1502
1.3		0.1470	0.1818
1.4		0.1837	0.2234
1.5		0.2400	0.2802
1.6		0.3073	0.3364
1.7		0.3479	0.3579
1.8		0.3476	0.3446
1.9		0.3310	0.3230
2.0		0.3208	0.3113
2.1		0.3304	0.3187
2.2		0.3705	0.3509
2.3		0.4262	0.3890
2.4		0.4361	0.3869
2.5		0.3982	0.3521
2.6		0.3528	0.3142
2.7		0.3188	0.2857
2.8		0.3054	0.2742
2.9		0.3240	0.2890
3.0		0.3474	0.3098

$$\epsilon_r = 3.19 + 0j$$

$$\text{Concentration} = 0.03$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.4120 \times 10^{-5}$	$0.5356 \times 10^{-5}$
0.2		$0.3338 \times 10^{-4}$	$0.4320 \times 10^{-4}$
0.3		$0.1150 \times 10^{-3}$	$0.1477 \times 10^{-3}$
0.4		0.2799	0.3561
0.5		0.5640	0.7091
0.6		$0.1007 \times 10^{-2}$	$0.1249 \times 10^{-2}$
0.7		0.1649	0.2016
0.8		0.2521	0.3034
0.9		0.3629	0.4298
1.0		0.4935	0.5759
1.1		0.6370	0.7342
1.2		0.7888	0.9013
1.3		0.9603	$0.1091 \times 10^{-1}$
1.4		$0.1193 \times 10^{-1}$	0.1340
1.5		0.1536	0.1681
1.6		0.1920	0.2018
1.7		0.2120	0.2147
1.8		0.2085	0.2067
1.9		0.1971	0.1938
2.0		0.1904	0.1868
2.1		0.1955	0.1912
2.2		0.2176	0.2106
2.3		0.2469	0.2334
2.4		0.2501	0.2321
2.5		0.2284	0.2113
2.6		0.2031	0.1885
2.7		0.1840	0.1714
2.8		0.1763	0.1645
2.9		0.1865	0.1734
3.0		0.2008	0.1859

$$\epsilon_r = 3.19 + 0j$$

Concentration = 0.01

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1647 \times 10^{-5}$	$0.1785 \times 10^{-5}$
0.2		$0.1330 \times 10^{-4}$	$0.1440 \times 10^{-4}$
0.3		0.4555	0.4923
0.4		$0.1101 \times 10^{-3}$	$0.1187 \times 10^{-3}$
0.5		0.2199	0.2364
0.6		0.3888	0.4165
0.7		0.6300	0.6721
0.8		0.9524	$0.1012 \times 10^{-2}$
0.9		$0.1355 \times 10^{-2}$	0.1433
1.0		0.1824	0.1920
1.1		0.2335	0.2447
1.2		0.2875	0.3004
1.3		0.3486	0.3635
1.4		0.4302	0.4468
1.5		0.5446	0.5604
1.6		0.6629	0.6727
1.7		0.7140	0.7158
1.8		0.6919	0.6891
1.9		0.6503	0.6461
2.0		0.6270	0.6226
2.1		0.6424	0.6373
2.2		0.7100	0.7019
2.3		0.7932	0.7781
2.4		0.7939	0.7738
2.5		0.7236	0.7042
2.6		0.6451	0.6283
2.7		0.5859	0.5714
2.8		0.5618	0.5484
2.9		0.5929	0.5781
3.0		0.6370	0.6196



$$\epsilon_r = 3.19 + 0j$$

Concentration = 0.003

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.5232 \times 10^{-6}$	$0.5356 \times 10^{-6}$
0.2		$0.4221 \times 10^{-5}$	$0.4320 \times 10^{-5}$
0.3		$0.1444 \times 10^{-4}$	$0.1477 \times 10^{-4}$
0.4		0.3483	0.3561
0.5		0.6941	0.7091
0.6		$0.1224 \times 10^{-3}$	$0.1249 \times 10^{-3}$
0.7		0.1978	0.2016
0.8		0.2981	0.3034
0.9		0.4227	0.4298
1.0		0.5672	0.5759
1.1		0.7240	0.7342
1.2		0.8896	0.9013
1.3		$0.1077 \times 10^{-2}$	$0.1091 \times 10^{-2}$
1.4		0.1325	0.1340
1.5		0.1667	0.1681
1.6		0.2010	0.2018
1.7		0.2146	0.2147
1.8		0.2070	0.2067
1.9		0.1942	0.1938
2.0		0.1872	0.1868
2.1		0.1917	0.1912
2.2		0.2113	0.2106
2.3		0.2348	0.2334
2.4		0.2340	0.2321
2.5		0.2130	0.2113
2.6		0.1900	0.1885
2.7		0.1727	0.1714
2.8		0.1657	0.1645
2.9		0.1748	0.1734
3.0		0.1875	0.1859

$$\epsilon_r = 3.19 + 0j$$

Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1772 \times 10^{-6}$	$0.1785 \times 10^{-6}$
0.2		$0.1429 \times 10^{-5}$	$0.1440 \times 10^{-5}$
0.3		0.4886	0.4923
0.4		$0.1178 \times 10^{-4}$	$0.1187 \times 10^{-4}$
0.5		0.2347	0.2364
0.6		0.4137	0.4165
0.7		0.6678	0.6721
0.8		$0.1005 \times 10^{-3}$	$0.1002 \times 10^{-3}$
0.9		0.1425	0.1433
1.0		0.1910	0.1920
1.1		0.2436	0.2447
1.2		0.2991	0.3004
1.3		0.3620	0.3635
1.4		0.4451	0.4468
1.5		0.5589	0.5604
1.6		0.6718	0.6727
1.7		0.7156	0.7158
1.8		0.6894	0.6891
1.9		0.6465	0.6461
2.0		0.6230	0.6226
2.1		0.6378	0.6373
2.2		0.7027	0.7019
2.3		0.7796	0.7781
2.4		0.7758	0.7738
2.5		0.7061	0.7042
2.6		0.6300	0.6283
2.7		0.5729	0.5714
2.8		0.5497	0.5484
2.9		0.5796	0.5781
3.0		0.6213	0.6196

$$\epsilon_r = 3.19 + 0j$$

Concentration = 0.0005

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.8893 \times 10^{-7}$	$0.8927 \times 10^{-7}$
0.2		$0.7172 \times 10^{-6}$	$0.7200 \times 10^{-6}$
0.3		$0.2425 \times 10^{-5}$	$0.2462 \times 10^{-5}$
0.4		0.5913	0.5935
0.5		$0.1178 \times 10^{-4}$	$0.1182 \times 10^{-4}$
0.6		0.2075	0.2082
0.7		0.3350	0.3361
0.8		0.5042	0.5057
0.9		0.7143	0.7163
1.0		0.9573	0.9598
1.1		$0.1221 \times 10^{-3}$	$0.1224 \times 10^{-3}$
1.2		0.1499	0.1502
1.3		0.1814	0.1818
1.4		0.2230	0.2234
1.5		0.2798	0.2802
1.6		0.3361	0.3364
1.7		0.3578	0.3579
1.8		0.3446	0.3446
1.9		0.3232	0.3230
2.0		0.3114	0.3113
2.1		0.3188	0.3187
2.2		0.3511	0.3509
2.3		0.3894	0.3890
2.4		0.3874	0.3869
2.5		0.3526	0.3512
2.6		0.3146	0.3142
2.7		0.2861	0.2857
2.8		0.2745	0.2742
2.9		0.2894	0.2890
3.0		0.3102	0.3098

$$\epsilon_r = 2.0 + 0.01j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1438 \times 10^{-3}$	$0.1444 \times 10^{-3}$
0.2		0.1592	0.1682
0.3		0.1998	0.2308
0.4		0.2800	0.3503
0.5		0.4154	0.5442
0.6		0.6220	0.8279
0.7		0.9146	$0.1212 \times 10^{-2}$
0.8		$0.1303 \times 10^{-2}$	0.1702
0.9		0.1790	0.2291
1.0		0.2362	0.2962
1.1		0.2994	0.3685
1.2		0.3651	0.4425
1.3		0.4300	0.5154
1.4		0.4927	0.5861
1.5		0.5554	0.6568
1.6		0.6236	0.7325
1.7		0.7042	0.8190
1.8		0.8012	0.9191
1.9		0.9114	$0.1028 \times 10^{-1}$
2.0		$0.1023 \times 10^{-1}$	0.1132
2.1		0.1120	0.1217
2.2		0.1194	0.1276
2.3		0.1248	0.1315
2.4		0.1291	0.1345
2.5		0.1337	0.1379
2.6		0.1398	0.1428
2.7		0.1477	0.1491
2.8		0.1567	0.1560
2.9		0.1650	0.1618
3.0		0.1709	0.1654

$$\epsilon_r = 2.0 + 0.01j$$

Concentration = 0.03

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.8640 \times 10^{-4}$	$0.8644 \times 10^{-4}$
0.2		0.9766	$0.1099 \times 10^{-3}$
0.3		$0.1272 \times 10^{-3}$	0.1385
0.4		0.1845	0.2102
0.5		0.2793	0.3265
0.6		0.4209	0.4967
0.7		0.6174	0.7275
0.8		0.8731	$0.1021 \times 10^{-2}$
0.9		$0.1188 \times 10^{-2}$	0.1375
1.0		0.1553	0.1777
1.1		0.1951	0.2211
1.2		0.2362	0.2655
1.3		0.2767	0.3092
1.4		0.3159	0.3516
1.5		0.3550	0.3941
1.6		0.3972	0.4395
1.7		0.4465	0.4914
1.8		0.5051	0.5514
1.9		0.5705	0.6166
2.0		0.6353	0.6791
2.1		0.6906	0.7301
2.2		0.7313	0.7657
2.3		0.7594	0.7888
2.4		0.7815	0.8068
2.5		0.8058	0.8276
2.6		0.8387	0.8567
2.7		0.8818	0.8947
2.8		0.9303	0.9361
2.9		0.9737	0.9701
3.0		$0.1003 \times 10^{-1}$	0.9923

$$\epsilon_r = 2.0 + 0.01j$$

Concentration = 0.01

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2884 \times 10^{-4}$	$0.2888 \times 10^{-4}$
0.2		0.3328	0.3365
0.3		0.4489	0.4615
0.4		0.6717	0.7006
0.5		$0.1035 \times 10^{-3}$	$0.1089 \times 10^{-3}$
0.6		0.1570	0.1656
0.7		0.2299	0.2425
0.8		0.3235	0.3404
0.9		0.4368	0.4583
1.0		0.5665	0.5924
1.1		0.7069	0.7370
1.2		0.8510	0.8851
1.3		0.9927	$0.1031 \times 10^{-2}$
1.4		$0.1130 \times 10^{-2}$	0.1172
1.5		0.1267	0.1314
1.6		0.1415	0.1465
1.7		0.1585	0.1638
1.8		0.1783	0.1838
1.9		0.2000	0.2055
2.0		0.2211	0.2264
2.1		0.2386	0.2434
2.2		0.2510	0.2552
2.3		0.2592	0.2629
2.4		0.2656	0.2689
2.5		0.2729	0.2759
2.6		0.2829	0.2856
2.7		0.2961	0.2983
2.8		0.3107	0.3120
2.9		0.3233	0.3237
3.0		0.3313	0.3308

$$\epsilon_r = 2.0 + 0.01j$$

Concentration = 0.003

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.8655 \times 10^{-5}$	$0.8664 \times 10^{-5}$
0.2		$0.1006 \times 10^{-4}$	$0.1009 \times 10^{-4}$
0.3		0.1373	0.1385
0.4		0.2076	0.2102
0.5		0.3217	0.3265
0.6		0.4889	0.4967
0.7		0.7161	0.7275
0.8		$0.1006 \times 10^{-3}$	$0.1021 \times 10^{-3}$
0.9		0.1355	0.1375
1.0		0.1754	0.1777
1.1		0.2184	0.2211
1.2		0.2624	0.2655
1.3		0.3057	0.3092
1.4		0.3478	0.3516
1.5		0.3898	0.3941
1.6		0.4349	0.4395
1.7		0.4865	0.4914
1.8		0.5463	0.5514
1.9		0.6115	0.6166
2.0		0.6742	0.6791
2.1		0.7257	0.7301
2.2		0.7617	0.7657
2.3		0.7853	0.7888
2.4		0.8036	0.8068
2.5		0.8247	0.8276
2.6		0.8541	0.8567
2.7		0.8927	0.8947
2.8		0.9347	0.9361
2.9		0.9705	0.9710
3.0		0.9926	0.9923

$$\epsilon_r = 2.0 + 0.01j$$

Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2885 \times 10^{-5}$	$0.2888 \times 10^{-5}$
0.2		0.3361	0.3365
0.3		0.4602	0.4615
0.4		0.6977	0.7006
0.5		$0.1083 \times 10^{-4}$	$0.1089 \times 10^{-4}$
0.6		0.1647	0.1656
0.7		0.2412	0.2425
0.8		0.3387	0.3404
0.9		0.4561	0.4583
1.0		0.5898	0.5924
1.1		0.7339	0.7370
1.2		0.8816	0.8851
1.3		$0.1027 \times 10^{-3}$	$0.1031 \times 10^{-3}$
1.4		0.1168	0.1172
1.5		0.1309	0.1314
1.6		0.1460	0.1465
1.7		0.1632	0.1638
1.8		0.1832	0.1838
1.9		0.2050	0.2055
2.0		0.2258	0.2264
2.1		0.2429	0.2434
2.2		0.2548	0.2552
2.3		0.2625	0.2629
2.4		0.2686	0.2689
2.5		0.2755	0.2759
2.6		0.2853	0.2856
2.7		0.2980	0.2983
2.8		0.3119	0.3120
2.9		0.3236	0.3237
3.0		0.3308	0.3308



$$\epsilon_r = 2.0 + 0.01j$$

$$\text{Concentration} = 0.0005$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1443 \times 10^{-5}$	$0.1444 \times 10^{-5}$
0.2		0.1681	0.1682
0.3		0.2304	0.2308
0.4		0.3496	0.3503
0.5		0.5429	0.5442
0.6		0.8257	0.8279
0.7		$0.1209 \times 10^{-4}$	$0.1212 \times 10^{-4}$
0.8		0.1698	0.1702
0.9		0.2286	0.2291
1.0		0.2955	0.2962
1.1		0.3677	0.3685
1.2		0.4417	0.4425
1.3		0.5144	0.5154
1.4		0.5850	0.5861
1.5		0.6556	0.6568
1.6		0.7312	0.7325
1.7		0.8176	0.8190
1.8		0.9176	0.9191
1.9		$0.1026 \times 10^{-3}$	$0.1028 \times 10^{-3}$
2.0		0.1135	0.1132
2.1		0.1216	0.1217
2.2		0.1275	0.1276
2.3		0.1314	0.1315
2.4		0.1344	0.1345
2.5		0.1378	0.1379
2.6		0.1427	0.1428
2.7		0.1491	0.1491
2.8		0.1560	0.1560
2.9		0.1618	0.1618
3.0		0.1654	0.1654

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1611 \times 10^{-4}$	$0.1725 \times 10^{-4}$
0.2		0.2993	0.3932
0.3		0.6820	0.9895
0.4		$0.1451 \times 10^{-3}$	$0.2146 \times 10^{-3}$
0.5		0.2762	0.4037
0.6		0.4780	0.6819
0.7		0.7652	$0.1061 \times 10^{-2}$
0.8		$0.1148 \times 10^{-2}$	0.1545
0.9		0.1629	0.2129
1.0		0.2197	0.2796
1.1		0.2826	0.3517
1.2		0.3481	0.4257
1.3		0.4129	0.4986
1.4		0.4755	0.5693
1.5		0.5379	0.6399
1.6		0.6057	0.7155
1.7		0.6860	0.8023
1.8		0.7834	0.9032
1.9		0.8949	$0.1024 \times 10^{-1}$
2.0		$0.1008 \times 10^{-1}$	0.1120
2.1		0.1108	0.1208
2.2		0.1185	0.1269
2.3		0.1239	0.1309
2.4		0.1282	0.1339
2.5		0.1328	0.1373
2.6		0.1389	0.1422
2.7		0.1470	0.1487
2.8		0.1563	0.1559
2.9		0.1649	0.1620
3.0		0.1711	0.1658

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.03

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.9935 \times 10^{-5}$	$0.1035 \times 10^{-4}$
0.2		$0.2018 \times 10^{-4}$	0.2359
0.3		0.4818	0.5937
0.4		$0.1034 \times 10^{-3}$	$0.1287 \times 10^{-3}$
0.5		0.1955	0.2422
0.6		0.3341	0.4019
0.7		0.5272	0.6364
0.8		0.7797	0.9269
0.9		$0.1091 \times 10^{-2}$	$0.1278 \times 10^{-2}$
1.0		0.1453	0.1678
1.1		0.1850	0.2111
1.2		0.2261	0.2554
1.3		0.2665	0.2991
1.4		0.3056	0.3416
1.5		0.3446	0.3840
1.6		0.3867	0.4293
1.7		0.4359	0.4814
1.8		0.4948	0.5419
1.9		0.5611	0.6082
2.0		0.6273	0.6722
2.1		0.6841	0.7248
2.2		0.7260	0.7615
2.3		0.7546	0.7851
2.4		0.7768	0.8031
2.5		0.8011	0.8239
2.6		0.8341	0.8533
2.7		0.8781	0.8923
2.8		0.9282	0.9353
2.9		0.9738	0.9721
3.0		$0.1005 \times 10^{-1}$	0.9948

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.01

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3402 \times 10^{-5}$	$0.3451 \times 10^{-5}$
0.2		0.7482	0.7864
0.3		$0.1853 \times 10^{-4}$	$0.1979 \times 10^{-4}$
0.4		0.4005	0.4291
0.5		0.7545	0.8074
0.6		$0.1278 \times 10^{-3}$	$0.1364 \times 10^{-3}$
0.7		0.1997	0.2121
0.8		0.2921	0.3090
0.9		0.4044	0.4259
1.0		0.5334	0.5593
1.1		0.6733	0.7035
1.2		0.8172	0.8514
1.3		0.9590	0.9971
1.4		$0.1096 \times 10^{-2}$	$0.1139 \times 10^{-2}$
1.5		0.1233	0.1280
1.6		0.1380	0.1431
1.7		0.1550	0.1605
1.8		0.1750	0.1806
1.9		0.1971	0.2027
2.0		0.2186	0.2241
2.1		0.2366	0.2416
2.2		0.2494	0.2538
2.3		0.2578	0.2617
2.4		0.2643	0.2677
2.5		0.2715	0.2746
2.6		0.2816	0.2844
2.7		0.2952	0.2974
2.8		0.3102	0.3118
2.9		0.3235	0.3240
3.0		0.3320	0.3316

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.003

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1030 \times 10^{-5}$	$0.1035 \times 10^{-5}$
0.2		0.2325	0.2359
0.3		0.5823	0.5937
0.4		$0.1261 \times 10^{-4}$	$0.1287 \times 10^{-4}$
0.5		0.2374	0.2422
0.6		0.4014	0.4091
0.7		0.6251	0.6364
0.8		0.9116	0.9269
0.9		$0.1258 \times 10^{-3}$	$0.1278 \times 10^{-3}$
1.0		0.1654	0.1678
1.1		0.2083	0.2111
1.2		0.2523	0.2554
1.3		0.2956	0.2991
1.4		0.3377	0.3416
1.5		0.3797	0.3840
1.6		0.4247	0.4293
1.7		0.4764	0.4814
1.8		0.5367	0.5419
1.9		0.6030	0.6082
2.0		0.6672	0.6722
2.1		0.7202	0.7248
2.2		0.7574	0.7615
2.3		0.7815	0.7851
2.4		0.7999	0.8031
2.5		0.8209	0.8239
2.6		0.8506	0.8533
2.7		0.8901	0.8923
2.8		0.9337	0.9353
2.9		0.9714	0.9721
3.0		0.9950	0.9948

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3443 \times 10^{-6}$	$0.3451 \times 10^{-6}$
0.2		0.7826	0.7864
0.3		$0.1996 \times 10^{-5}$	$0.1979 \times 10^{-5}$
0.4		0.4262	0.4291
0.5		0.8021	0.8074
0.6		$0.1355 \times 10^{-4}$	$0.1364 \times 10^{-4}$
0.7		0.2109	0.2121
0.8		0.3073	0.3090
0.9		0.4237	0.4259
1.0		0.5567	0.5593
1.1		0.7004	0.7035
1.2		0.8479	0.8514
1.3		0.9932	0.9971
1.4		$0.1134 \times 10^{-3}$	$0.1139 \times 10^{-3}$
1.5		0.1275	0.1280
1.6		0.1426	0.1431
1.7		0.1599	0.1605
1.8		0.1801	0.1806
1.9		0.2021	0.2027
2.0		0.2235	0.2241
2.1		0.2411	0.2416
2.2		0.2534	0.2538
2.3		0.2613	0.2617
2.4		0.2674	0.2677
2.5		0.2743	0.2746
2.6		0.2841	0.2844
2.7		0.2972	0.2974
2.8		0.3116	0.3118
2.9		0.3239	0.3240
3.0		0.3316	0.3316

$$\epsilon_r = 2.0 + 0.001j$$

Concentration = 0.0005

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1723 \times 10^{-6}$	$0.1725 \times 10^{-6}$
0.2		0.3922	0.3932
0.3		0.9864	0.9895
0.4		$0.2138 \times 10^{-5}$	$0.2146 \times 10^{-5}$
0.5		0.4024	0.4037
0.6		0.6797	0.6819
0.7		$0.1058 \times 10^{-4}$	$0.1061 \times 10^{-4}$
0.8		0.1541	0.1545
0.9		0.2124	0.2129
1.0		0.2790	0.2796
1.1		0.3510	0.3517
1.2		0.4248	0.4257
1.3		0.4976	0.4986
1.4		0.5682	0.5693
1.5		0.6387	0.6399
1.6		0.7142	0.7155
1.7		0.8009	0.8023
1.8		0.9017	0.9032
1.9		$0.1012 \times 10^{-3}$	$0.1014 \times 10^{-3}$
2.0		0.1119	0.1120
2.1		0.1207	0.1208
2.2		0.1268	0.1269
2.3		0.1307	0.1309
2.4		0.1338	0.1339
2.5		0.1372	0.1373
2.6		0.1421	0.1422
2.7		0.1487	0.1487
2.8		0.1558	0.1559
2.9		0.1620	0.1620
3.0		0.1658	0.1658

$$\epsilon_r = 2.0 + 0j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1921 \times 10^{-5}$	$0.3125 \times 10^{-5}$
0.2		$0.1557 \times 10^{-4}$	$0.2500 \times 10^{-4}$
0.3		0.5357	0.8431
0.4		$0.1310 \times 10^{-3}$	$0.1995 \times 10^{-3}$
0.5		0.2608	0.3881
0.6		0.4619	0.6657
0.7		0.7486	$0.1004 \times 10^{-2}$
0.8		$0.1131 \times 10^{-2}$	0.1527
0.9		0.1612	0.2111
1.0		0.2179	0.2778
1.1		0.2808	0.3499
1.2		0.3463	0.4238
1.3		0.4110	0.4967
1.4		0.4735	0.5674
1.5		0.5359	0.6380
1.6		0.6037	0.7137
1.7		0.6840	0.8004
1.8		0.7815	0.9014
1.9		0.8931	$0.1012 \times 10^{-1}$
2.0		$0.1007 \times 10^{-1}$	0.1119
2.1		0.1107	0.1207
2.2		0.1183	0.1268
2.3		0.1238	0.1308
2.4		0.1281	0.1338
2.5		0.1327	0.1373
2.6		0.1388	0.1422
2.7		0.1469	0.1487
2.8		0.1562	0.1559
2.9		0.1649	0.1620
3.0		0.1712	0.1659



$$\epsilon_r = 2.0 + 0j$$

Concentration = 0.03

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1439 \times 10^{-5}$	$0.1875 \times 10^{-5}$
0.2		$0.1158 \times 10^{-4}$	$0.1500 \times 10^{-4}$
0.3		0.3940	0.5058
0.4		0.9435	$0.1197 \times 10^{-3}$
0.5		$0.1862 \times 10^{-3}$	0.2329
0.6		0.3244	0.3994
0.7		0.5171	0.6363
0.8		0.7693	0.9164
0.9		$0.1080 \times 10^{-2}$	$0.1267 \times 10^{-2}$
1.0		0.1442	0.1667
1.1		0.1839	0.2099
1.2		0.2250	0.2543
1.3		0.2654	0.2980
1.4		0.3045	0.3404
1.5		0.3434	0.3828
1.6		0.3855	0.4282
1.7		0.4734	0.4803
1.8		0.4936	0.5409
1.9		0.5600	0.6072
2.0		0.6264	0.6714
2.1		0.6834	0.7242
2.2		0.7254	0.7610
2.3		0.7541	0.7847
2.4		0.7763	0.8027
2.5		0.8005	0.8235
2.6		0.8336	0.8529
2.7		0.8777	0.8920
2.8		0.9280	0.9352
2.9		0.9738	0.9722
3.0		$0.1005 \times 10^{-1}$	0.9951

$$\epsilon_r = 2.0 + 0j$$

Concentration = 0.01

ka	Im(K/k) Multiple Scattering	Single Scattering
0.1	$0.5762 \times 10^{-6}$	$0.6250 \times 10^{-6}$
0.2	$0.4616 \times 10^{-5}$	$0.5000 \times 10^{-5}$
0.3	$0.1560 \times 10^{-4}$	$0.1686 \times 10^{-4}$
0.4	0.3704	0.3990
0.5	0.7233	0.7762
0.6	$0.1246 \times 10^{-3}$	$0.1331 \times 10^{-3}$
0.7	0.1963	0.2088
0.8	0.2886	0.3055
0.9	0.4008	0.4222
1.0	0.5297	0.5556
1.1	0.6696	0.6998
1.2	0.8135	0.8477
1.3	0.9552	0.9934
1.4	$0.1039 \times 10^{-2}$	$0.1135 \times 10^{-2}$
1.5	0.1230	0.1276
1.6	0.1377	0.1427
1.7	0.1547	0.1601
1.8	0.1746	0.1803
1.9	0.1967	0.2024
2.0	0.2184	0.2238
2.1	0.2364	0.2414
2.2	0.2492	0.2537
2.3	0.2577	0.2616
2.4	0.2641	0.2676
2.5	0.2714	0.2745
2.6	0.2815	0.2843
2.7	0.2950	0.2973
2.8	0.3102	0.3117
2.9	0.3235	0.3241
3.0	0.3321	0.3317

$$\epsilon_r = 2.0 + 0j$$

Concentration = 0.003

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1831 \times 10^{-6}$	$0.1875 \times 10^{-6}$
0.2		$0.1465 \times 10^{-5}$	$0.1500 \times 10^{-5}$
0.3		0.4945	0.5058
0.4		$0.1171 \times 10^{-4}$	$0.1197 \times 10^{-4}$
0.5		0.2281	0.2328
0.6		0.3917	0.3994
0.7		0.6150	0.6263
0.8		0.9011	0.9164
0.9		$0.1247 \times 10^{-3}$	$0.1267 \times 10^{-3}$
1.0		0.1643	0.1667
1.1		0.2072	0.2099
1.2		0.2512	0.2543
1.3		0.2945	0.2980
1.4		0.3366	0.3404
1.5		0.3785	0.3828
1.6		0.4235	0.4282
1.7		0.4753	0.4803
1.8		0.5356	0.5409
1.9		0.6020	0.6072
2.0		0.6664	0.6714
2.1		0.7196	0.7242
2.2		0.7569	0.7610
2.3		0.7811	0.7847
2.4		0.7995	0.8027
2.5		0.8205	0.8235
2.6		0.8502	0.8529
2.7		0.8898	0.8920
2.8		0.9336	0.9352
2.9		0.9715	0.9722
3.0		0.9953	0.9951

$$\epsilon_r = 2.0 + 0j$$

Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.6201 \times 10^{-7}$	$0.6250 \times 10^{-7}$
0.2		$0.4961 \times 10^{-6}$	$0.4999 \times 10^{-6}$
0.3		$0.1674 \times 10^{-5}$	$0.1686 \times 10^{-5}$
0.4		0.3961	0.3990
0.5		0.7708	0.7762
0.6		$0.1323 \times 10^{-4}$	$0.1331 \times 10^{-4}$
0.7		0.2075	0.2088
0.8		0.3038	0.3055
0.9		0.4201	0.4222
1.0		0.5530	0.5556
1.1		0.6967	0.6998
1.2		0.8442	0.8447
1.3		0.9895	0.9934
1.4		$0.1130 \times 10^{-3}$	$0.1135 \times 10^{-3}$
1.5		0.1271	0.1276
1.6		0.1422	0.1427
1.7		0.1595	0.1601
1.8		0.1797	0.1803
1.9		0.2018	0.2024
2.0		0.2233	0.2238
2.1		0.2409	0.2414
2.2		0.2532	0.2537
2.3		0.2612	0.2617
2.4		0.2672	0.2676
2.5		0.2742	0.2745
2.6		0.2840	0.2843
2.7		0.2969	0.2973
2.8		0.3112	0.3117
2.9		0.3228	0.3241
3.0		0.3314	0.3317

$$\epsilon_r = 2.0 + 0j$$

$$c = 0.0005$$

ka	Multiple Scattering	Im(K/k)	Single Scattering
0.1	$0.3113 \times 10^{-7}$		$0.3125 \times 10^{-7}$
0.2	$0.2490 \times 10^{-6}$		$0.2500 \times 10^{-6}$
0.3	0.8399		0.8431
0.4	$0.1988 \times 10^{-5}$		$0.1995 \times 10^{-5}$
0.5	0.3868		0.3881
0.6	0.6635		0.6657
0.7	$0.1041 \times 10^{-4}$		$0.1044 \times 10^{-4}$
0.8	0.1523		0.1527
0.9	0.2106		0.2111
1.0	0.2771		0.2778
1.1	0.3491		0.3499
1.2	0.4230		0.4238
1.3	0.4957		0.4967
1.4	0.5663		0.5674
1.5	0.6368		0.6380
1.6	0.7124		0.7137
1.7	0.7990		0.8004
1.8	0.9000		0.9014
1.9	$0.1001 \times 10^{-3}$		$0.1012 \times 10^{-3}$
2.0	0.1118		0.1119
2.1	0.1206		0.1207
2.2	0.1267		0.1268
2.3	0.1307		0.1308
2.4	0.1337		0.1338
2.5	0.1372		0.1373
2.6	0.1421		0.1422
2.7	0.1486		0.1487
2.8	0.1558		0.1559
2.9	0.1620		0.1620
3.0	0.1659		0.1659

(Perfect Conducting Spheres ) Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3755 \times 10^{-4}$	$0.6265 \times 10^{-4}$
0.2		$0.3073 \times 10^{-3}$	$0.5048 \times 10^{-3}$
0.3		$0.1075 \times 10^{-2}$	$0.1722 \times 10^{-2}$
0.4		0.2661	0.4134
0.5		0.5442	0.8143
0.6		0.9769	$0.1398 \times 10^{-1}$
0.7		$0.1575 \times 10^{-1}$	0.2134
0.8		0.2288	0.2903
0.9		0.2977	0.3514
1.0		0.3467	0.3817
1.1		0.3656	0.3804
1.2		0.3574	0.3578
1.3		0.3334	0.3266
1.4		0.3047	0.2956
1.5		0.2784	0.2693
1.6		0.2580	0.2491
1.7		0.2435	0.2345
1.8		0.2335	0.2240
1.9		0.2257	0.2154
2.0		0.2181	0.2072
2.1		0.2097	0.1984
2.2		0.2005	0.1891
2.3		0.1910	0.1797
2.4		0.1818	0.1707
2.5		0.1734	0.1627
2.6		0.1662	0.1558
2.7		0.1600	0.1500
2.8		0.1545	0.1449
2.9		0.1495	0.1403
3.0		0.1447	0.1358

(Perfect Conducting Spheres ) Concentration = 0.03

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2861 \times 10^{-4}$	$0.3759 \times 10^{-4}$
0.2		$0.2319 \times 10^{-3}$	$0.3029 \times 10^{-3}$
0.3		0.7993	$0.1033 \times 10^{-2}$
0.4		$0.1944 \times 10^{-2}$	0.2481
0.5		0.3895	0.4886
0.6		0.6834	0.8385
0.7		$0.1075 \times 10^{-1}$	$0.1280 \times 10^{-1}$
0.8		0.1518	0.1742
0.9		0.1920	0.2108
1.0		0.2175	0.2290
1.1		0.2241	0.2282
1.2		0.2157	0.2147
1.3		0.1993	0.1960
1.4		0.1813	0.1774
1.5		0.1654	0.1616
1.6		0.1531	0.1495
1.7		0.1443	0.1407
1.8		0.1381	0.1344
1.9		0.1332	0.1293
2.0		0.1284	0.1243
2.1		0.1232	0.1190
2.2		0.1176	0.1134
2.3		0.1119	0.1078
2.4		0.1064	0.1024
2.5		0.1015	$0.9764 \times 10^{-2}$
2.6		$0.9721 \times 10^{-2}$	0.9350
2.7		0.9357	0.9000
2.8		0.9041	0.8693
2.9		0.8751	0.8415
3.0		0.8472	0.8147

(Perfect Conducting Spheres ) Concentration = 0.01

ka	Im(K/k) Multiple Scattering	Single Scattering
0.1	$0.1454 \times 10^{-4}$	$0.1253 \times 10^{-4}$
0.2	0.9308	$0.1010 \times 10^{-3}$
0.3	$0.3183 \times 10^{-3}$	0.3445
0.4	0.7664	0.8269
0.5	$0.1516 \times 10^{-2}$	$0.1629 \times 10^{-2}$
0.6	0.2618	0.2795
0.7	0.4034	0.4267
0.8	0.5556	0.5805
0.9	0.6825	0.7028
1.0	0.7520	0.7635
1.1	0.7576	0.7607
1.2	0.7180	0.7157
1.3	0.6579	0.6533
1.4	0.5963	0.5912
1.5	0.5434	0.5386
1.6	0.5027	0.4982
1.7	0.4734	0.4691
1.8	0.4524	0.4480
1.9	0.4354	0.4309
2.0	0.4191	0.4144
2.1	0.4016	0.3968
2.2	0.3829	0.3781
2.3	0.3639	0.3593
2.4	0.3459	0.3415
2.5	0.3297	0.3255
2.6	0.3158	0.3117
2.7	0.3039	0.3000
2.8	0.2936	0.2898
2.9	0.2842	0.2805
3.0	0.2752	0.2716



(Perfect Conducting Spheres ) Concentration = 0.003

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.3670 \times 10^{-5}$	$0.3759 \times 10^{-5}$
0.2		$0.2958 \times 10^{-4}$	$0.3029 \times 10^{-4}$
0.3		$0.1010 \times 10^{-3}$	$0.1033 \times 10^{-3}$
0.4		0.2426	0.2481
0.5		0.4784	0.4886
0.6		0.8225	0.8385
0.7		$0.1259 \times 10^{-2}$	$0.1280 \times 10^{-2}$
0.8		0.1719	0.1742
0.9		0.2090	0.2108
1.0		0.2280	0.2290
1.1		0.2280	0.2282
1.2		0.2149	0.2147
1.3		0.1964	0.1960
1.4		0.1779	0.1774
1.5		0.1620	0.1616
1.6		0.1499	0.1495
1.7		0.1411	0.1407
1.8		0.1348	0.1344
1.9		0.1297	0.1293
2.0		0.1247	0.1243
2.1		0.1195	0.1190
2.2		0.1139	0.1134
2.3		0.1082	0.1078
2.4		0.1028	0.1024
2.5		$0.9802 \times 10^{-3}$	$0.9764 \times 10^{-3}$
2.6		0.9387	0.9350
2.7		0.9034	0.8999
2.8		0.8728	0.8693
2.9		0.8449	0.8415
3.0		0.8180	0.8147

(Perfect Conducting Spheres ) Concentration = 0.001

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1243 \times 10^{-5}$	$0.1253 \times 10^{-5}$
0.2		$0.1002 \times 10^{-4}$	$0.1010 \times 10^{-4}$
0.3		0.3419	0.3445
0.4		0.8208	0.8269
0.5		$0.1617 \times 10^{-3}$	$0.1629 \times 10^{-3}$
0.6		0.2778	0.2795
0.7		0.4244	0.4267
0.8		0.5780	0.5805
0.9		0.7008	0.7028
1.0		0.7624	0.7635
1.1		0.7605	0.7607
1.2		0.7159	0.7157
1.3		0.6538	0.6533
1.4		0.5918	0.5912
1.5		0.5391	0.5386
1.6		0.4986	0.4982
1.7		0.4695	0.4691
1.8		0.4485	0.4480
1.9		0.4313	0.4309
2.0		0.4148	0.4144
2.1		0.3973	0.3968
2.2		0.3786	0.3781
2.3		0.3598	0.3593
2.4		0.3419	0.3415
2.5		0.3259	0.3255
2.6		0.3121	0.3117
2.7		0.3003	0.3000
2.8		0.2902	0.2898
2.9		0.2809	0.2805
3.0		0.2719	0.2716

(Perfect Conducting Spheres ) Concentration = 0.0005

ka	Im(K/k) Multiple Scattering	Single Scattering
0.1	$0.6240 \times 10^{-6}$	$0.6265 \times 10^{-6}$
0.2	$0.5028 \times 10^{-5}$	$0.5048 \times 10^{-5}$
0.3	$0.1716 \times 10^{-4}$	$0.1722 \times 10^{-4}$
0.4	0.4119	0.4134
0.5	0.8115	0.8143
0.6	$0.1393 \times 10^{-3}$	$0.1398 \times 10^{-3}$
0.7	0.2128	0.2134
0.8	0.2896	0.2903
0.9	0.3509	0.3514
1.0	0.3815	0.3817
1.1	0.3803	0.3804
1.2	0.3579	0.3578
1.3	0.3268	0.3266
1.4	0.2958	0.2956
1.5	0.2694	0.2693
1.6	0.2492	0.2491
1.7	0.2346	0.2345
1.8	0.2241	0.2240
1.9	0.2155	0.2154
2.0	0.2073	0.2072
2.1	0.1985	0.1984
2.2	0.1892	0.1891
2.3	0.1798	0.1797
2.4	0.1708	0.1707
2.5	0.1628	0.1627
2.6	0.1559	0.1558
2.7	0.1501	0.1500
2.8	0.1450	0.1449
2.9	0.1403	0.1403
3.0	0.1359	0.1358

$$\epsilon_T = 80.18 + 6.35j$$

$$\text{Concentration} = 0.01$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.8934 \times 10^{-4}$	$0.8931 \times 10^{-4}$
0.2		$0.3913 \times 10^{-3}$	$0.3933 \times 10^{-3}$
0.3		$0.4259 \times 10^{-2}$	$0.4250 \times 10^{-2}$
0.4			
0.5		$0.1082 \times 10^{-1}$	$0.1092 \times 10^{-1}$
0.6		$0.3643 \times 10^{-2}$	$0.3782 \times 10^{-2}$
0.7		$0.1342 \times 10^{-1}$	$0.1359 \times 10^{-1}$
0.8		$0.1110 \times 10^{-1}$	$0.1135 \times 10^{-1}$
0.9		$0.7253 \times 10^{-2}$	$0.7318 \times 10^{-2}$
1.0		$0.8616 \times 10^{-2}$	$0.8724 \times 10^{-2}$
1.1		$0.1062 \times 10^{-1}$	$0.1056 \times 10^{-1}$
1.2		$0.9262 \times 10^{-2}$	$0.9120 \times 10^{-2}$
1.3		0.6398	0.6358
1.4		0.7427	0.7351
1.5		0.6912	0.6815
1.6		0.5652	0.5588
1.7		0.5623	0.5560
1.8		0.5320	0.5254
1.9		0.5331	0.5257
2.0		0.4895	0.4827
2.1		0.4434	0.4375
2.2		0.4372	0.4312
2.3		0.4300	0.4237
2.4		0.3924	0.3867
2.5		0.3645	0.3596
2.6		0.3688	0.3635
2.7		0.3512	0.3461
2.8		0.3312	0.3266
2.9		0.3209	0.3164
3.0		0.3113	0.3069

$$\epsilon_T = 80.18 + 6.35j$$

$$\text{Concentration} = 0.05$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.4481 \times 10^{-3}$	$0.4465 \times 10^{-3}$
0.2		$0.1918 \times 10^{-2}$	$0.1967 \times 10^{-2}$
0.3		$0.2141 \times 10^{-1}$	$0.2125 \times 10^{-1}$
0.4			
0.5		$0.5235 \times 10^{-1}$	$0.5459 \times 10^{-1}$
0.6		0.1564	0.1891
0.7		0.6390	0.6795
0.8		0.5018	0.5675
0.9		0.3469	0.3659
1.0		0.4041	0.4362
1.1		0.5329	0.5281
1.2		0.4891	0.4560
1.3		0.3250	0.3179
1.4		0.3823	0.3676
1.5		0.3625	0.3408
1.6		0.2935	0.2794
1.7		0.2916	0.2780
1.8		0.2772	0.2627
1.9		0.2794	0.2628
2.0		0.2564	0.2414
2.1		0.2319	0.2188
2.2		0.2293	0.2156
2.3		0.2262	0.2118
2.4		0.2060	0.1934
2.5		0.1912	0.1798
2.6		0.1938	0.1817
2.7		0.1845	0.1731
2.8		0.1737	0.1633
2.9		0.1683	0.1582
3.0		0.1631	0.1534

$$\epsilon_T = 80.18 + 6.35j$$

$$\text{Concentration} = 0.03$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2683 \times 10^{-3}$	$0.2678 \times 10^{-3}$
0.2		$0.1162 \times 10^{-2}$	$0.1180 \times 10^{-2}$
0.3		$0.1282 \times 10^{-2}$	$0.1275 \times 10^{-1}$
0.4			
0.5		$0.3193 \times 10^{-1}$	$0.3275 \times 10^{-1}$
0.6		0.1013	0.1134
0.7		0.3927	0.4077
0.8		0.3174	0.3405
0.9		0.2132	0.2195
1.0		0.2510	0.2617
1.1		0.3203	0.3168
1.2		0.2860	0.2736
1.3		0.1938	0.1907
1.4		0.2266	0.2205
1.5		0.2128	0.2045
1.6		0.1731	0.1677
1.7		0.1721	0.1668
1.8		0.1632	0.1576
1.9		0.1640	0.1577
2.0		0.1506	0.1448
2.1		0.1363	0.1313
2.2		0.1345	0.1294
2.3		0.1326	0.1271
2.4		0.1209	0.1160
2.5		0.1122	0.1079
2.6		0.1136	0.1091
2.7		0.1082	0.1038
2.8		0.1020	$0.9797 \times 10^{-2}$
2.9		$0.9880 \times 10^{-2}$	0.9492
3.0		0.9582	0.9206

$$\epsilon_T = 63.1 + 32.1j$$

$$\text{Concentration} = 0.003$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1410 \times 10^{-3}$	$0.1407 \times 10^{-3}$
0.2		$0.4398 \times 10^{-3}$	$0.4389 \times 10^{-3}$
0.3		$0.1732 \times 10^{-2}$	$0.1729 \times 10^{-2}$
0.4		0.2843	0.2839
0.5		0.2145	0.2154
0.6		0.2219	0.2233
0.7		0.2572	0.2591
0.8		0.3005	0.3023
0.9		0.3166	0.3175
1.0		0.3050	0.3051
1.1		0.2864	0.2859
1.2		0.2622	0.2614
1.3		0.2355	0.2346
1.4		0.2126	0.2118
1.5		0.1953	0.1946
1.6		0.1822	0.1815
1.7		0.17203	0.1714
1.8		0.1636	0.1630
1.9		0.1558	0.1551
2.0		0.1480	0.1473
2.1		0.1402	0.1396
2.2		0.1327	0.1321
2.3		0.1257	0.1251
2.4		0.1195	0.1190
2.5		0.1141	0.1136
2.6		0.1094	0.1089
2.7		0.1053	0.1048
2.8		0.1014	0.1010
2.9		$0.9772 \times 10^{-3}$	$0.9728 \times 10^{-3}$
3.0		$0.9416 \times 10^{-3}$	$0.9373 \times 10^{-3}$

$$\epsilon_T = 63.1 + 32.1j$$

$$\text{Concentration} = 0.01$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.4722 \times 10^{-3}$	$0.4690 \times 10^{-3}$
0.2		$0.1473 \times 10^{-2}$	$0.1463 \times 10^{-2}$
0.3		$0.5801 \times 10^{-2}$	$0.5762 \times 10^{-2}$
0.4		0.9502	0.9464
0.5		0.7087	0.7179
0.6		0.7285	0.7443
0.7		0.8427	0.8636
0.8		0.9877	$0.1008 \times 10^{-1}$
0.9		$0.1048 \times 10^{-1}$	0.1058
1.0		$0.1016 \times 10^{-1}$	0.1017
1.1		$0.9581 \times 10^{-2}$	$0.9531 \times 10^{-2}$
1.2		0.8798	0.8715
1.3		0.7911	0.7821
1.4		0.7145	0.7061
1.5		0.6564	0.6486
1.6		0.6124	0.6050
1.7		0.5784	0.5712
1.8		0.5502	0.5432
1.9		0.5241	0.5171
2.0		0.4980	0.4911
2.1		0.4719	0.4653
2.2		0.4466	0.4403
2.3		0.4232	0.4171
2.4		0.4024	0.3966
2.5		0.3842	0.3787
2.6		0.3684	0.3631
2.7		0.3544	0.3493
2.8		0.3414	0.3365
2.9		0.3290	0.3243
3.0		0.3170	0.3124



$$\epsilon_T = 63.1 + 32.1j$$

$$\text{Concentration} = 0.03$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1436 \times 10^{-2}$	$0.1407 \times 10^{-2}$
0.2		$0.4479 \times 10^{-2}$	$0.4389 \times 10^{-2}$
0.3		$0.1763 \times 10^{-1}$	$0.1729 \times 10^{-1}$
0.4		$0.2874 \times 10^{-1}$	$0.2839 \times 10^{-1}$
0.5		0.2074	0.2154
0.6		0.2094	0.2233
0.7		0.2406	0.2591
0.8		0.2839	0.3023
0.9		0.3068	0.3175
1.0		0.3025	0.3051
1.1		0.2892	0.2859
1.2		0.2681	0.2614
1.3		0.2421	0.2346
1.4		0.2189	0.2118
1.5		0.2012	0.1946
1.6		0.1877	0.1815
1.7		0.1774	0.1714
1.8		0.1690	0.1630
1.9		0.1611	0.1551
2.0		0.1532	0.1473
2.1		0.1453	0.1396
2.2		0.1376	0.132
2.3		0.1304	0.1251
2.4		0.1240	0.1190
2.5		0.1184	0.1136
2.6		0.1135	0.1089
2.7		0.1092	0.1048
2.8		0.1052	0.1010
2.9		0.1014	$0.9728 \times 10^{-2}$
3.0		$0.9764 \times 10^{-2}$	$0.9373 \times 10^{-2}$

$$\epsilon_T = 63.1 + 32.1j$$

$$\text{Concentration} = 0.05$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2429 \times 10^{-2}$	$0.2345 \times 10^{-2}$
0.2		$0.7566 \times 10^{-2}$	$0.7315 \times 10^{-2}$
0.3		$0.2974 \times 10^{-1}$	$0.2881 \times 10^{-1}$
0.4		0.4832	0.4732
0.5		0.3378	0.3589
0.6		0.3347	0.3722
0.7		0.3812	0.4318
0.8		0.4519	0.5039
0.9		0.4965	0.5292
1.0		0.4977	0.5085
1.1		0.4823	0.4766
1.2		0.4516	0.4357
1.3		0.4098	0.3910
1.4		0.3712	0.3531
1.5		0.3412	0.3243
1.6		0.3186	0.3025
1.7		0.3013	0.2856
1.8		0.2872	0.2716
1.9		0.2741	0.2585
2.0		0.2610	0.2456
2.1		0.2476	0.2326
2.2		0.2346	0.2201
2.3		0.2224	0.2086
2.4		0.2115	0.1983
2.5		0.2020	0.1894
2.6		0.1937	0.1816
2.7		0.1863	0.1746
2.8		0.1794	0.1682
2.9		0.1727	0.1621
3.0		0.1663	0.1562

$$\epsilon_T = 7.87 + 13.23j$$

$$\text{Concentration} = 0.003$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.6874 \times 10^{-3}$	$0.6866 \times 10^{-3}$
0.2		$0.7938 \times 10^{-3}$	$0.7935 \times 10^{-3}$
0.3		$0.1004 \times 10^{-2}$	$0.1005 \times 10^{-2}$
0.4		0.1354	0.1358
0.5		0.1872	0.1881
0.6		0.2531	0.2547
0.7		0.3213	0.3233
0.8		0.3731	0.3746
0.9		0.3910	0.3914
1.0		0.3734	0.3727
1.1		0.3367	0.3356
1.2		0.2980	0.2968
1.3		0.2654	0.2643
1.4		0.2408	0.2397
1.5		0.2227	0.2217
1.6		0.2091	0.2082
1.7		0.1978	0.1969
1.8		0.1874	0.1865
1.9		0.1771	0.1762
2.0		0.1669	0.1661
2.1		0.1572	0.1564
2.2		0.1484	0.1476
2.3		0.1406	0.1399
2.4		0.1339	0.1332
2.5		0.1280	0.1274
2.6		0.1228	0.1222
2.7		0.1179	0.1174
2.8		0.1133	0.1127
2.9		0.1088	0.1083
3.0		0.1046	0.1040

$\epsilon_r = 7.87 + 13.23j$		Concentration = 0.01	
ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.2298 \times 10^{-2}$	$0.2289 \times 10^{-2}$
0.2		$0.2648 \times 10^{-2}$	$0.2645 \times 10^{-2}$
0.3		0.3337	0.3350
0.4		0.4482	0.4527
0.5		0.6169	0.6269
0.6		0.8319	0.8488
0.7		$0.1056 \times 10^{-1}$	$0.1078 \times 10^{-1}$
0.8		$0.1231 \times 10^{-1}$	$0.1249 \times 10^{-1}$
0.9		0.1299	0.1305
1.0		0.1249	0.1243
1.1		0.1131	0.1119
1.2		$0.1003 \times 10^{-1}$	$0.9892 \times 10^{-2}$
1.3		$0.8937 \times 10^{-2}$	0.8809
1.4		0.8105	0.7990
1.5		0.7497	0.7391
1.6		0.7040	0.6939
1.7		0.6662	0.6564
1.8		0.6312	0.6217
1.9		0.5966	0.5874
2.0		0.5624	0.5536
2.1		0.5298	0.5214
2.2		0.5000	0.4921
2.3		0.4738	0.4663
2.4		0.4511	0.4440
2.5		0.4315	0.4247
2.6		0.4138	0.4074
2.7		0.3974	0.3912
2.8		0.3817	0.3757
2.9		0.3666	0.3608
3.0		0.3522	0.3467

$$\epsilon_T = 7.87 + 13.23j$$

$$\text{Concentration} = 0.03$$

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.6952 \times 10^{-3}$	$0.6866 \times 10^{-2}$
0.2		$0.7969 \times 10^{-2}$	$0.7935 \times 10^{-2}$
0.3		$0.9943 \times 10^{-2}$	$0.1005 \times 10^{-1}$
0.4		$0.1319 \times 10^{-1}$	0.1358
0.5		0.1793	0.1881
0.6		0.2397	0.2547
0.7		0.3038	0.3233
0.8		0.3578	0.3746
0.9		0.3851	0.3914
1.0		0.3774	0.3727
1.1		0.3460	0.3356
1.2		0.3085	0.2968
1.3		0.2753	0.2643
1.4		0.2497	0.2397
1.5		0.2309	0.2217
1.6		0.2169	0.2082
1.7		0.2054	0.1969
1.8		0.1947	0.1865
1.9		0.1841	0.1762
2.0		0.1736	0.1661
2.1		0.1635	0.1564
2.2		0.1543	0.1476
2.3		0.1462	0.1399
2.4		0.1392	0.1332
2.5		0.1332	0.1274
2.6		0.1277	0.1222
2.7		0.1226	0.1174
2.8		0.1178	0.1127
2.9		0.1131	0.1083
3.0		0.1086	0.1040

$$\epsilon_T = 7.87 + 13.23j$$

Concentration = 0.05

ka	Im(K/k)	Multiple Scattering	Single Scattering
0.1		$0.1170 \times 10^{-1}$	$0.1144 \times 10^{-1}$
0.2		0.1333	0.1323
0.3		0.1647	0.1675
0.4		0.2158	0.2263
0.5		0.2898	0.3134
0.6		0.3836	0.4244
0.7		0.4850	0.5388
0.8		0.5757	0.6243
0.9		0.6305	0.6523
1.0		0.6298	0.6212
1.1		0.5852	0.5593
1.2		0.5252	0.4946
1.3		0.4697	0.4405
1.4		0.4260	0.3995
1.5		0.3938	0.3695
1.6		0.3699	0.3470
1.7		0.3504	0.3282
1.8		0.3323	0.3108
1.9		0.3144	0.2937
2.0		0.2964	0.2768
2.1		0.2792	0.2607
2.2		0.2635	0.2460
2.3		0.2496	0.2332
2.4		0.2376	0.2220
2.5		0.2271	0.2124
2.6		0.2178	0.2037
2.7		0.2090	0.1956
2.8		0.2006	0.1879
2.9		0.1925	0.1804
3.0		0.1848	0.1734

$\epsilon_T = 3.19 + 0j$		Concentration = 0.01	
ka	Im(K/k)	Multiple Scattering	Single Scattering
3.1		$0.5895 \times 10^{-2}$	$0.5741 \times 10^{-2}$
3.2		0.5133	0.5013
3.3		0.4447	0.4357
3.4		0.3862	0.3793
3.5		0.3520	0.3461
3.6		0.3740	0.3673
3.7		0.3878	0.3814
3.8		0.3276	0.3235
3.9		0.2868	0.2837
4.0		0.2496	0.2474
4.1		0.2072	0.2058
4.2		0.1821	0.1808
4.3		0.2195	0.2173
4.4		0.1989	0.1976
4.5		0.1675	0.1663
4.6		0.1687	0.1672
4.7		0.1573	0.1561
4.8		0.1277	0.1268
4.9		0.1202	0.1193
5.0		0.1716	0.1700
5.1		0.1288	0.1277
5.2		0.1325	0.1312
5.3		0.1589	0.1571
5.4		0.1538	0.1520
5.5		0.1300	0.1286
5.6		0.1462	0.1446
5.7		0.1564	0.1544
5.8		0.1459	0.1440
5.9		0.1606	0.1583
6.0		0.1945	0.1912
6.1		0.1727	0.1699
7.0		0.1642	0.1616
8.0			0.1370

$\epsilon_T = 3.19 + 0j$		Concentration = 0.01	
ka	Im(K/k)	Multiple Scattering	Single Scattering
7.2		$0.1587 \times 10^{-2}$	$0.1562 \times 10^{-2}$
7.4		0.1528	0.1509
7.6		0.1423	0.1408
7.8		0.1270	0.1257
8.0			0.1370
8.2		0.1037	0.1027
8.4		$0.9890 \times 10^{-3}$	$0.9807 \times 10^{-3}$
8.6		0.9260	0.9917
8.8		0.8014	0.7944
9.0		0.8325	0.8241
9.2		0.8411	0.8317
9.4		0.8129	0.8029
9.6		0.8166	0.0859
9.8		0.9263	0.9127
10.0		0.9250	0.9108
10.2		0.9005	0.8867
10.4		$0.1023 \times 10^{-2}$	$0.1006 \times 10^{-2}$
10.6		$0.9971 \times 10^{-3}$	$0.9812 \times 10^{-3}$
10.8		0.9467	0.9328
11.0		0.9729	0.9581
11.2		0.9344	0.9219
11.4		0.8928	0.8826
11.6		0.7909	0.7828
11.8		0.7811	0.7739
12.0		0.7844	0.7775
12.2		0.6480	0.6437
12.4		0.6567	0.6519
12.6		0.6499	0.6441
12.8		0.5790	0.5748
13.0		0.7622	0.7532
13.2			0.5819
13.4		0.6124	0.6057
13.6		0.5655	0.5584
13.8		0.6180	0.6093
14.0		0.7070	0.6961
15.0		0.6265	0.6186
16.0		0.5885	0.5838



**END**

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